

Total Lightning Characteristics with Respect to Radar-Derived Mesocyclone Strength

Sarah M. Stough¹, Lawrence D. Carey¹, Christopher J. Schultz^{1,2}

¹ Department of Atmospheric Science, University of Alabama in Huntsville (UAH)

² NASA MSFC

Recent work investigating the microphysical and kinematic relationship between a storm's updraft, its total lightning production, and manifestations of severe weather has resulted in development of tools for improved nowcasting of storm intensity. The total lightning jump algorithm, which identifies rapid increases in total lightning flash rate that often precede severe events, has shown particular potential to benefit warning operations. Maximizing this capability of total lightning and its operational implementation via the lightning jump may best be done through its fusion with radar and radar-derived intensity metrics. Identification of a mesocyclone, or quasi-steady rotating updraft, in Doppler velocity is the predominant radar-inferred early indicator of severe potential in a convective storm. Fused lightning-radar tools that capitalize on the most robust intensity indicators would allow enhanced situational awareness for increased warning confidence. A foundational step toward such tools comes from a better understanding of the updraft-centric relationship between intensification of total lightning production and mesocyclone development and strength. The work presented here utilizes a sample of supercell case studies representing a spectrum of severity. These storms are analyzed with respect to total lightning flash rate and the lightning jump alongside mesocyclone strength derived objectively from the National Severe Storms Laboratory (NSSL) Mesocyclone Detection Algorithm (MDA) and maximum azimuthal shear through a layer. Early results indicate that temporal similarities exist in the trends between total lightning flash rate and low- to mid-level rotation in supercells. Other characteristics such as polarimetric signatures of rotation, flash size, and cloud-to-ground flash ratio are explored for added insight into the significance of these trends with respect to the updraft and related processes of severe weather production.